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# DIGITAL COMPUTER NEWSLETTER

OFFICE OF NAVAL RESEARCH · MATHEMATICAL SCIENCES DIVISION

Vol. 4, No. 4

October 1952

The purpose of this newsletter  
is to provide a medium for the  
interchange, among interested  
persons, of information concerning  
recent developments in  
various digital computer projects

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### LIST OF COMPUTING SERVICES

The attached list of organizations offering computing services is incomplete and will be continued in the next issue of the Digital Computer Newsletter. It is suggested that additional organizations providing such facilities or services forward information on them to the Office of Naval Research, Code 434, prior to 1 December 1952.

**Correction:** Due to an editorial error, in the July 1952 issue, it was stated that the access time of the four ENIAC function tables was reduced from 5AT to 1AT. It should read from 5AT to 2AT.

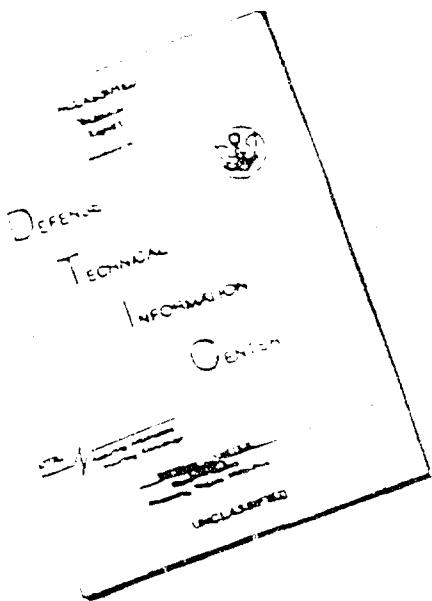
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## DIGITAL COMPUTERS

### NAVAL PROVING GROUND CALCULATORS

The Aiken Relay Calculator (Mark II) has been employed on ballistic and guided missile problems since the last report. Operating efficiency has averaged 88 per cent. This figure is based on two scheduled eight-hour shifts with no scheduled downtime for maintenance or engineering improvements. A further significant fact is that Mark II is being operated with no engineer assigned to the operating staff.

Design is underway and work is progressing toward the addition of IBM card input-output to Mark II so that it will be more adaptable to ballistic problems and problems involving the reduction of large amounts of data.

Since the last report the Mark III Electronic Calculator has worked on ballistic problems and in addition has just completed a mapping problem involving the solution of 703 simultaneous linear algebraic equations which consisted of approximately 30,000 non-zero coefficients. During this period, a regular scheduled semi-annual maintenance inspection was also observed. Intermittent troubles are still a source of a considerable amount of downtime and emphasis is being placed on the investigation of methods to improve reliability.

### THE UNIVAC

In June, 1952 UNIVAC SYSTEM II was turned over to the customer's personnel. The entire moving operation, installation, and final tests were completed. UNIVAC SYSTEM III which passed its acceptance test in April, 1952 is now in the process of being shipped to its permanent location. UNIVAC SYSTEM IV satisfactorily passed its acceptance test on August 22, 1952. It is now in operation in its test location until plans for its delivery have been completed.

Design work has progressed on a high-speed printer and a self-checking Card-to-Tape Converter. These two new additions to the UNIVAC SYSTEM will be available during 1953.

### WHIRLWIND I

The average weekly operation time of Whirlwind I has continued to increase. As of 4 August, 99 computer hours per week were assigned to military, industrial, and academic problems. During the last three months the computer has yielded 85% useful time, permitting the operation of a total of 1169 programs (exclusive of military applications). No new problems were undertaken during the summer.

During the last three weeks in August, the computer was shut down for the installation and testing of a new input-output system. The Whirlwind system contains a permanent magnetic tape system, 16 display outputs for oscilloscopes, a Fairchild camera arrangement for photographing displays, a photoelectric paper-tape reader, and two new FL Flexowriter units, each with a printer, paper-tape punch, and mechanical paper-tape reader. The old Flexowriter equipment can also be used in the system and will be available on a standby basis until additional FL units, on order, arrive. A new control desk consolidates, in a convenient arrangement, the terminal equipment with the control, communication, and monitoring facilities required to operate the computer.

The old input-output system utilized separate orders to operate each type of terminal equipment; the new system uses the same order to operate any unit. This elimination of the old orders has been most important because it has released their positions for other types of operations. The single order selects the desired unit and the mode of operation by means of its address section.

The 21 July through 1 August MIT summer course on Digital Computers and their Application, sponsored by the Digital Computer Laboratory and the Electrical Engineering Department, was highly successful. Ninety-six people were enrolled, representing six academic

Institutions, seven aerodynamical organizations, three business-machine firms, eight chemical and petroleum companies, four electronic organizations, eight government agencies, five insurance companies, and 18 diversified industrial companies and businesses.

## THE COMPUTER RESEARCH CORPORATION COMPUTERS

### CADAC 102-A

The CADAC 102-A has recently been augmented with the following improvements:

- (1) Punched card facilities for input and output.
- (2) Operation with from one to eight magnetic tape units, each capable of independent simultaneous block search while computing takes place, providing up to 33,600,000 binary digits of storage.
- (3) Addition of an eight word high speed buffer storage register and other improvements to provide computing speeds of three to five times greater than CADAC (CRC 102). By proper programming up to 80 complete three address operations per second can be performed.
- (4) Inclusion of double precision multiply and divide commands and a scale factor command to facilitate double precision, floating point and automatic scaling programs.
- (5) Inclusion of logical shift command to facilitate interpretive sub-routine programming.
- (6) Inclusion of test magnitude command in addition to test algebraic command to facilitate branching and zero test transfers.
- (7) The inclusion of a test switch command to facilitate program de-bugging (similar to breakpoint command with four switches available).
- (8) Inclusion of punched paper tape read command, mechanizing the use of the Flexo-writer tapes.

Production of CADAC 102-A's has been started.

### CRC 105

CRC 105, the first decimal digital differential analyzer to be produced is under test and will be delivered this fall. It is decimal throughout and can be filled, it is claimed, more than four times faster than binary machines of similar type. This machine has 60 integrators with an accuracy of six decimal digits per integrator. Constant multipliers are provided with each integrator facilitating scaling and reducing the necessity of using integrators for constant multiplication.

It is equipped with a single automatic typewriter which prints results from all integrators. Plotting and empirical function equipment is provided, capable of plotting as many as 12 functions and introducing as many as 12 empirical functions simultaneously. Initial conditions can be stored and a problem re-run from the same initial conditions conveniently by pushing a "Restore Initial Conditions Button." Any required changes may be made from the decimal keyboard.

Saturable type non-linearities can be handled by using any integrator to limit the maximum and minimum of any variable to specified values. An automatic integrator overflow stop with visual indicator has been provided to facilitate scaling.

It is possible to stop the computer and print any desired variables at fixed intervals or

at mathematical points such as maxima, minima, inflections and pre-determined values of variables. Upon completion of printing, the machine will automatically start computation through the next interval.

Decisions, such as cutting off the output of integrators depending upon the sign of the integrand of another integrator, can be made by using an integrator as a decision device.

The company has several of these machines in production.

#### CRC 107

Two CRC 107, general purpose decimal and alphabetic data processing computers are under construction and will be completed sometime late in 1952 or early 1953. The internal drum memory of the CRC 107 will store 1,000 words of high speed storage and 10,000 words of medium speed storage on the same drum. The numbers and commands are in coded decimal form throughout the entire system.

These machines are capable of operating with a large magnetic tape file of up to 10,000,000 words of eleven decimal digits per word.

Separate magnetic tape editing and printing equipment is provided to prepare, print from, verify and edit magnetic tapes. Information may be located in the magnetic tape file at very high rates of speed because each magnetic tape unit is provided with its own searching capacities and computing may proceed independently of several simultaneous searches. Alphabetic information can be handled directly by the tape and printing equipment, as well as by the computer.

A high speed printer enables printing to take place from tapes or computer as speeds of 100 words per second (120 characters per line, 10 lines per second). Complete flexibility in preparing various forms is possible using the high speed printer. The machine can accept or transmit information to and from punched cards, punched paper tape and typewriter with keyboard.

The Company has developed as a separate item a block search magnetic tape unit, denoted as CRC 126, which is used with the CADAC 102-A or CRC 107.

#### MOORE SCHOOL AUTOMATIC COMPUTER (MSAC)

The construction of the Algebraic Unit of MSAC is continuing. Several design projects have been completed including a logical redesign of the Timer as a full dynamic device, with no flip-flops. Along with this there has been the design of high-power driver circuits and distribution systems.

Additional phases of construction to be initiated shortly will include the Computer Cycle Counter and Automatic Control.

#### RAYTHEON AUTOMATIC COMPUTER (RAYDAC)

The RAYDAC, Raytheon Digital Automatic Computer, successfully completed its final acceptance tests on 19 July 1952.

One phase of the tests required an exhaustive sequence of reading, recording, and searching on the four magnetic tape external memory units of the computer under automatic machine control. This test proceeded continuously for 1 hour and 23 minutes, during which period the magnetic tape operations were completed without error.

The last phase of the acceptance tests required the computer to solve successfully a set

of fourteen simultaneous nonlinear ordinary differential equations. This problem, involving the evaluation of nearly 50,000 output quantities, was completed without error or machine stoppage in approximately 59 minutes in the computer's acceptance run.

The RAYDAC has been disassembled and is being shipped to the Naval Air Missile Test Center, Point Mugu, California, where it will be utilized for missile data reduction computations as well as for many scientific and engineering problems requiring the use of a large-scale, general-purpose, high-speed digital computer.

#### THE SWAC

IBM collator input has been in use on the SWAC for the last three months giving a read-in rate of 40 words per second. This card input has also been used to operate the SWAC as a card programmed computer.

A punched card output system has been installed with a read-out rate of some 17 words per second.

An alternate deflection system for the cathode ray tube memory has been developed. The new system generates the deflection signals at a level high enough to drive the cathode ray memory tubes directly without further amplification of the signal.

Several RCA three-inch experimental cathode ray tubes have been received and are currently undergoing tests.

The following computations were performed on SWAC during the quarter:

<u>Problem</u>	<u>Task Number</u>	<u>Sponsor</u>
Systematic and Random Errors	1101-53-1101/52-29	USAF
Control System Equations	1101-53-1101/52-30	USAF
Probability Distributions	1101-53-1101/49-1a	USN
Boundary-Value Problem	1101-53-1101/49-1a	USN
Sets of Linear Equations	1101-53-1101/49-1a	USN
Primality Tests for Mersenne Numbers	1101-11-5101/50-4	USN
Character Sums	1101-53-1101/49-1a	USN
Continued Fractions	1101-53-1101/49-1a	USN

Information on any of these computations may be found under the appropriate task numbers in "Projects and Publications of the National Applied Mathematics Laboratories," National Bureau of Standards.

#### ABERDEEN PROVING GROUND COMPUTERS

##### THE ORDVAC

The ORDVAC has been in operation at the Aberdeen Proving Ground since 9 March 1952 and has already successfully solved a large group of important problems.

Several improvements have been installed including a switch for clear, tape, and IBM input instructions. IBM read and punch equipment controlled by a coded sequence for conversion to and from decimal form has been in successful operation since June 1952.

##### THE EDVAC

The EDVAC has had some set-backs due to power supply failures, however recent weeks have shown as much as 100 hours available machine time. Testing of the 10,000 word drum

designed by the Brush Development Company is continuing, as is test of IBM input-output equipment.

#### THE ENIAC

The ENIAC continues to serve as an important part of the computing facilities of the BRL, showing an available machine time somewhat in excess of the newer machines.

~~Recently an address coincidence detector was added in order to facilitate the code checking of new programs.~~

#### THE BELL

The Bell computers have continued in use for their entire available time. However, because of their slow rate of operation there has been an increasing tendency to neglect the Bell Computers in favor of the faster machines.

#### IBM

The IBM equipment including the Relay Calculators and CPC continue to serve primarily as card processing equipment for the rearranging and transferring of information from one machine to another.

#### C. S. I. R. O. MARK I

This machine was publicly demonstrated at a conference during August 1951 at Sydney, New South Wales; and has been in service since October of that year.

The computer is of the serial binary electronic type, with a main word length of 20 digits. The main store is of mercury acoustic type, at a pulse rate of 333 kcs, with a capacity up to 1024 words of 1 ms. access time. An auxiliary store of the asynchronous magnetic drum type and of 1024 word capacity and access time of 10 ms. is incorporated. Operating speed is about 500 commands per second.

Input at present is via punched cards read in a column by column fashion, and output by page printer.

The code is of the "two address" type, and a 20 digit command consists of two main 5 digit addresses, a "source" and a "destination," together with a third 10 digit or sub-address which specifies only a particular location in the stores. Commands are stored serially.

Besides the stores a number of one-word arithmetical acoustic registers are provided.

Program design uses the sub-routine principle and special devices are adopted to render all standard routines free to be placed anywhere in the store, and to facilitate standardized linking into and out of them.

Improvements under way include use of high speed tape for input and output; the extension of the magnetic store to 4096 words, and doubling of the operating speed by elimination of dead time.

Since October 1951 the library of standard routines has been steadily increased, and computations tackled have included chemical, flutter, coordinate data and time series analyses, the computation of some function tables, the evaluation of multiparameter integrals and the solution of partial and ordinary differential equations.

## DATA PROCESSING AND CONVERSION EQUIPMENT

### GRAPH PLOTTER

The Logistics Research Company, 141 South Pacific Avenue, Redondo Beach, California, has developed a digital graph plotter, the "Logrinc." It automatically plots one variable against another algebraically in incremental steps, in response to electrical impulses. The plotting area is 12" x 18", or a continuous strip of 12" paper can be used. Each step is 1/64" along any axis. Plotting speed is up to 20 steps per second, and steps along both axes may be taken simultaneously.

### NOTICE

A "Review of Electronic Digital Computers" contains the papers presented at the Joint American Institute of Electrical Engineers, Institute of Radio Engineers Computer Conference, held in Philadelphia, Pennsylvania, December 1951.

This publication brings together detailed information concerning existing large-scale digital computers which are in productive operation. Additional copies may be obtained at the rate of \$3.50 each from Mr. R. S. Gardner, Technical Secretary, American Institute of Electrical Engineers, 33 West 39th Street, New York, New York.

A Joint Conference similar to the one last year will be held 10, 11, and 12 December 1952 in New York City. The subject of the meeting will be Input and Output Equipment and there will be exhibits of existing input-output devices as well as papers describing them and their operation.

## AVAILABILITY OF DIGITAL COMPUTING SERVICES

### GOVERNMENT AGENCIES

#### (1) Air Force

(a) Name and Address of Contact: Commanding General, Wright Air Development Center, Wright Patterson Air Force Base, Ohio, Attn: WCRKM2.

(b) Facilities and their Location: SWAC Automatic Computer. Institute for Numerical Analysis, National Bureau of Standards, University of California, 405 Hilgard Avenue, Los Angeles 24, California (see National Bureau of Standards).

Mark I and IV Automatic Computers. Harvard University, Computation Laboratory, Cambridge 39, Massachusetts.

Three Card Programmed Calculators (CPCs) and four REACs. Computation Research Section, Wright Air Development Center, Wright Patterson Air Force Base, Ohio.

(c) Coding and Mathematical Services: are available at all the above activities.

(d) To Whom Available: Air Force Facilities and Air Force Contractors.

#### (2) Army

(a) Office, Chief of Ordnance, Washington 25, D. C.

(b) Automatic Computers include ORDVAC, EDVAC, ENIAC, two Bell Relay. Also available are two IBM Relay Computers and one Card Programmed Calculator. Ballistic Research Laboratories, Aberdeen Proving Ground, Aberdeen, Maryland.

(c) Available

(d) Primarily available to government agencies and their contractors, limited availability to non-government agencies.

#### (3) Navy

(a) Chief, Bureau of Ordnance, Washington 25, D. C. Attn: Re3

(b) Aiken Relay and Mark III (Electronic) Automatic Calculators. Naval Proving Ground, Dahlgren, Virginia.

(c) Available.

(d) Government agencies and government contractors.

#### (4) National Bureau of Standards

(a) Franz Alt, and Milton Abramowitz, NBS, Washington, D. C.

(b) SEAC Automatic Computer, up to date standard IBM machine and desk calculators. NBS, Washington, D. C.

(c) Available (research mathematicians also available for consultation).

(d) In general only to government agencies and their contractors.

- (a) Franz Alt (NBS, Washington, D. C.), Arnold D. Hestenes (Institute for Numerical Analysis, University of California, Los Angeles, California).
- (b) SWAC Automatic Computer, up to date IBM machines and desk Calculators. NBS, Institute for Numerical Analysis.
- (c) Available (research mathematicians also available for consultation).
- (d) In general only to government agencies and their contractors.

#### NON-GOVERNMENT

##### **(5) Battelle Memorial Institute**

- (a) Jack Belzer, Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio.
- (b) IBM punched-card equipment, including a 604-type electronic calculator (a linear differential analyzer with twenty amplifiers will soon be available). Battelle Memorial Institute.
- (c) Available.
- (d) No restriction

##### **(6) Burroughs Adding Machine Company**

- (a) Alex Orden, Burroughs Adding Machine Company, New Products Division, 511 N. Broad Street, Philadelphia 23, Pennsylvania.
- (b) General purpose automatic digital computer with magnetic drum memory and punched tape input-output. Burroughs Adding Machine Co.
- (c) Available.
- (d) General (not limited to government agencies and their contractors).

##### **(7) Financial Publishing Company**

- (a) Charles H. Gushee, Mathematical Tables Division, 82 Brookline Avenue, Boston 15, Massachusetts.
- (b) Desk Calculators and IBM equipment including two CPCs. Financial Publishing Company.
- (c) Control boards will be wired by Financial Publishing Company.
- (d) No restriction

##### **(8) International Business Machines Corporation**

- (a) Manager or Sales Representative, at local IBM office.
- (b) Model II CPC, 1670 Wilshire Boulevard, Los Angeles, California. Models I and II CPC, 604, 101, 590 Madison Avenue, New York, N. Y. Model II CPC. 1146 19th Street, N. W., Washington, D. C.
- (c) Available (research mathematicians also available for consultation).
- (d) No restriction

In addition to technical computing services, handled by staffs of math matelangs as listed above, IBM maintains Service Bureaus in most of the larger cities throughout the United States, which can be located through the local telephone directory. These Service Bureaus handle large volumes of business in the accounting field. Many of these have 602A multipliers or 604 electronic multipliers, and can provide machine service, provided the customer does his own mathematical planning and programming. IBM also provides mathematical consultant service which is available upon inquiry at the local IBM office.

(9) Moore School of Electrical Engineering

- (a) Donald F. Hunt, University of Pennsylvania Computing Center, Moore School of Electrical Engineering, Philadelphia 4, Pennsylvania.
- (b) IBM equipment including a CPC Mechanical Differential Analyzer also available. Moore School of Electrical Engineering.
- (c) Available.
- (d) Government agencies and their contractors, private industry, and universities.

(10) Telecomputing Corporation

- (a) William D. Bell, Telecomputing Corporation, 133 East Santa Anita Avenue, Burbank, California.
- (b) IBM equipment including three CPCs and auxiliary devices including automatic graph readers and digital plotters. Telecomputing Corporation.
- (c) Available.
- (d) No restriction.

**PLANNED FACILITIES**

(1) Engineering Research Associates

- (a) Howard Engstrom, ERA, 507 18th Street South, Arlington, Virginia, James G. Miles, ERA, 1902 West Minnehaha Avenue, St. Paul W4, Minn.
- (b) ERA 1101 Automatic Computer. ERA, Arlington, VA.
- (c) Available.
- (d) No restriction.